E7.4-10090
CR-136002

BUREAU DE RECHERCHES GÉOLOGIQUES ET MINIÈRES

SERVICE GÉOLOGIQUE NATIONAL

BRGM

(E74-10090) GEOLOGICAL STUDY IN THE SOUTHERN PART OF MADAGASCAR Progress Report, Jun. - Oct. 1973 (Bureau de Recherches Geologiques et Minieres) 17 p HC $3.00 CSCL 08G G3/13

N74-11201

Unclas 00090

Département carte géologique et géologie générale

BUREAU DE RECHERCHES GÉOLOGIQUES ET MINIÈRES

SERVICE GÉOLOGIQUE NATIONAL

GEOLOGICAL STUDY IN THE SOUTHERN PART OF MADAGASCAR

Type II report
Report date : Oct 1973

Département carte géologique et géologie générale
B.P. 6009 – 45018 Orléans Cédex – Tél.: (38) 66.06.60

1 - SR N°	2 - Type of report	3 - Recipient's catalog n°

4 - Title

Geological study in the southern part of Madagascar.

5 - Report date

Oct. 1973

6 - Period covered

June/Oct. 1973

7 - Principal investigator

G. WEECKSTEEN

8 - Number of pages

12

9 - Name and address of principal investigators organization :

B.R.G.M. Service photogéologie
B.P. 6009
45018 - ORLEANS cedex

10 - Principal investigator

Report N° 4

11 - G.S.F.C. Technical Monitor

George ENSOR

12 - Sponsoring Agency name and adress

CNES - Brétigny - France -

13 - Key words (selected by principal investigator)

Geology

14 - Supplementary notes

No supplementary ERTS image has been received since the last report.

This report has been prepared by B. KOCH

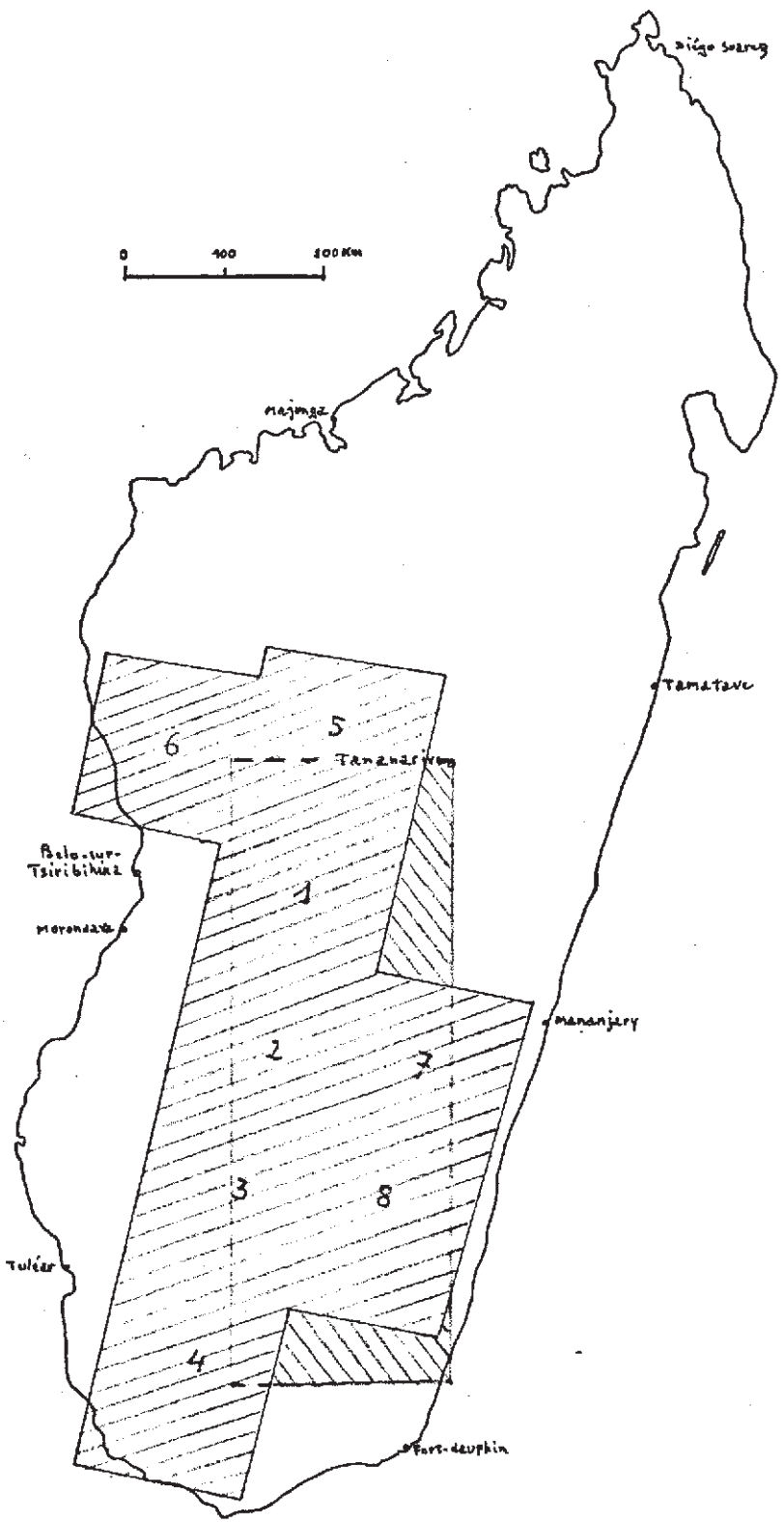
15 - Abstract

The quality of enlargments at the scale of 1/1 000 000 and even 1/500 000 is very good.

The main results obtained concern the structural features : systems of faulting, continuity of great lithological belts, relationships between the different units.

The results concerning the lithology are not so conspicuous, the accuracy of lithological boundaries being not steady and being linked to various factors (morphology, vegetation ...).

LOCATION MAP



LEGEND

not yet recepted area

covered area

numbering of images :

1 = 1074 - 06253 Erts
2 = 1074 - 06255 "
3 = 1074 - 06262 "
4 = 1074 - 06264 "
5 = 1074 - 06250 "
6 = 1075 - 06305 "
7 = 1073 - 06201 "
8 = 1073 - 06203 "

10,0 20,0 30,0 40,0 50,0 60,0 70,0

I - INTRODUCTION

1.1. Remembering of the project

The scientific aim of our ERTS-A proposal, was to study the main structural elements, which were to discuss, according to some recents works. It was to locate the already known geological units, to prove or not the continuity of some lithological belts and understand their relationships, at last to find, eventually, superficial mineral deposits, such as bauxites.

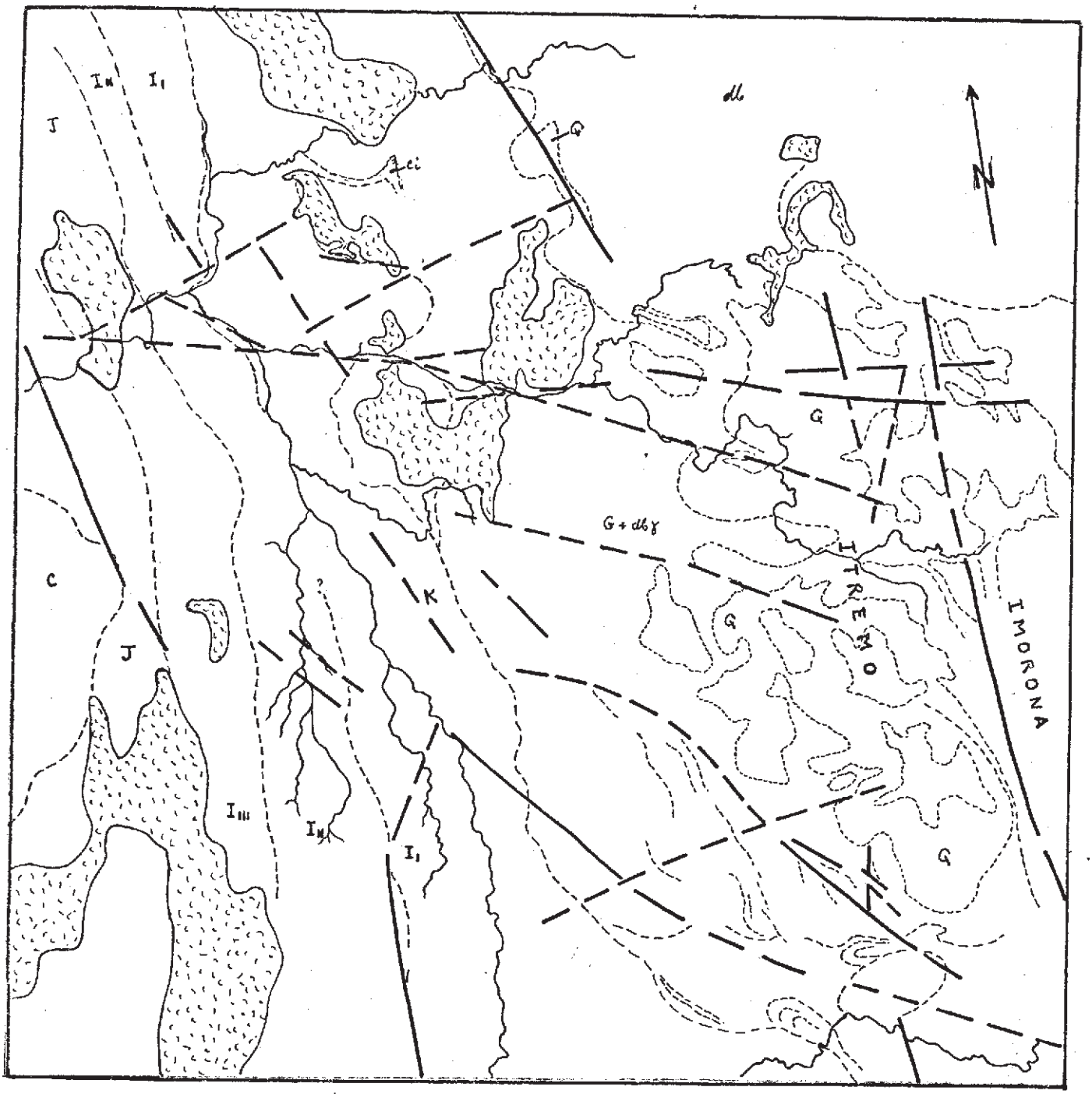
1.2. Summary of the accomplishments during the period

June - October 1973

None new imagery was receipt during this last period (cf. the gaps of covering on the location map of the preceeding page).

The study has followed with existing data. A beginning of interpretation on enlargments at the scale of 1/500 000, has been made. The quality of these enlargments is very good and the advantage of this scale is to compare the images with a detailed geological map, showing all formations.

Two sketchmaps are included in this report in order to show some main results obtained (see the following sheets Fig.1 and Fig. 2).



ID NUMBER 1074-06253 SUN EL 52 OCT 72 ITREMO MOUNTAIN AREA
BAND USED : 5 LITHOLOGY : MIXTURE SCALE : 1.000.000 appr.

LEGEND

Clouds

River

Photolineations and faults

Lithological limits

Symbols : I_I, I_{II}, I_{III} - Isalo formations

J - Jurassic C - Cretaceous

Ci : cipolins Q : quartzits G : gneiss db, dbγ : migmatits, migmatit-granits

ID NUMBER 1073-06203 SUN EL 51 OCT 72 RANOTSARA AND KALAMBATITRA

BAND USED : 5 LITHOLOGY : MIXTURE SCALE : 1.000.000 2ppr.

LEGEND

Clouds

River

Photolineations and faults

Lithological limits

Lithological symbols : al = lateritic claystones q = quartzits ci = Cipolins

γ = granits γ = stratoid gr. mb = migmatits G = gneiss

σ = syenits

II - COMPREHENSIVE RESULTS

The main results put in light are :

2.1. Structural features

- A/ The reality of a main faulting zone, running along the western boarder of the Andringitra and the Vohibe areas and extending to the North, between the Itremo and the Imorona, (images 1073-06201 and 1074-06253, Fig. 1). The lineation running between the Itremo and the Imorona would be the trace of an overlapping towards East, according to J. CHANTRAINE and G. HOTTIN (oral information) but the image doesn't allow to see that.

In the same region (image 1073-06201), the Tafia basement is well delimited by a fault, NE - SW in direction, which belongs to this faulting system.

- B/ A complex faulting system, called "Ranotsara - Ranomena trend" crosses the island from SE to NW. From NW of Ihosy and towards the north, faults are running with a roughly N - S direction.

The Ranotsara-Ranomena faulting has been studied by recent works, particularly by a detailed magnetic prospection at a scale of 1/100 000.

It was previously admitted that this fault was of major importance, separating Androy and Vohibory systems. Later works (4)* agree that this fault is not from first importance, from a palaeogeographic point of view, the formations on both sides having the same age.

---

* Bibliographic reference.

It seems of some interest to underline here that beds which look alike, are visible (Fig. 2) on both sides of the fault and that exits a continuity of the series beyond Ihosy towards the north, proved by the continuity of the granit strates, this being in favour of the last above mentionned idea[1].

In the eastern part of Kalambatitra (Southern area of the fault) may be observed N - NE to N E lineaments, whereas in the western and north-western part, the directions are roughly N - S. This area of Kalambatitra-Analasoa (particularly the core of granit and migmatit-granit) is affected by a great number of transversal secondary fractures (see on image 1073-06203 - Fig.2).

The N - S Betroka-Ihosy lineament separates this fractured zone from a zone of different type (facies, morphology, structure) to the west. Close to this lineament (zone of Ihosy), beds seem to be seen with an extension towards the south, up to the north vicinity of Betroka[2].

Let us notice that the basement, west of this alignment, is affected by a fault system straightly NE - SW in direction, conspicuously underlined by the rivers courses.

- C/ Let us point out to a possible closure of the Ihosy series (Androyan System) towards the north-west, north of the Mangoky - Matsiara rivers, under sedimentary cover (image 1074-06255).

1- It is a question of previous beds, transformed in stratoïd granits, having the same age than the metamorphism.

2- This is in favour of the non-closure of the "cipolin gulf" in the Zomandao river area, but of a continuity towards the south. We shall see the interest of this in the § III.

- D/ Great lineaments, more or less N-S in direction, are observed, which delimit quite well the basins (and underline particularly the Sedimentary-Basement boarder).

- E/ In the northern part of the studied area (west of Tananarive) big transversal faults (approximately E-W), have been observed, which were not pointed out on the geological maps. In particular, a big fracture, south of Ambohiby, divides two countries of apparent different feature (see on image 1074-06250).

In the same area, faults indicated by Radelli's map may have some extension, or be relayed by other fractures of same orientation , such as the E-W fracture, north of Tananarive, which is bending towards N-W more to the west. In the same point of view, the NW-SE fault stopped north of Ambohiby massif of granit, may be extended towards the south, running close to the Itasy basaltic overflowing.

2.2. Lithological features

The comparison of MSS images and a map showing the lithological formations, is pretty good.

The boarder of sedimentary basins is well indicated, and also the subdivisions inside the sedimentary formations, because of colour or other criteria of the rocks.

This allows to hope the possibility of surveying the problem of bauxite research, when we'll have the complete covering towards the east coast. Already, some areas covered by lateritic shales may be recognized.

It may be usefull to give hereunder, some test of correspondance between the different formations and their appearances on images :

a) Sakoa (K1)

Chiefly constituted by red claystones and black shales.

Appears in pretty dark grey (images 1074-06255 and 06262).

Locally, on images 06255, the grade is higher towards the top of the formation (not explained).

b) Sakamena (K2)

Red coloured formations are dominant.

Appears slightly lighter grey. (images 1074-06253, 06255, 06262). It is obviously lighter than Basement in contact.

c) Isalo (I1)

Light coloured sandstones. Diaclases with siliceous veins and pseudo-veins of hard quartz.

It appaears with about the same grade tone than K2 (images 1074-06253 and 06255 - band 5).

In this area the two formations are covered with the same sort of vegetation (savannah of trees and bushes, with locally thick dry forest on arenaceous acid soil). On the contrary, on image 1974-06262, it appears much darker grey than K2 with bands 4, 5 and 6, because in this area grows on I_1, a vegetation of low sclerophylle forest - damp type.

d) Isalo (I_{II})

Red claystones, rarely green or variegated in colour, with some light coloured sandstones.

It appears much lighter than I1. The explanation is that the dominant red colour is reflected on band 5 and becomes white on the image. On band 6 we observe the same phenomena

but not so clearly. On band 4 it appears also very light (because of the presence of some mixtures of green colours absorbed ?). Examples may be seen on image 1074-06255 and better still on image 1074-06253.

On the contrary, on image 1075-06305, appears a uniform greyish back-ground (for all bands) and the difference between I_I and I_{II} is not obvious. It may be due to a different ratio sandstones/claystones in this area, but more probably to the printing of the positive papers, all the formations appearing dark.

e) Isalo I_{III}

The lithological continental facies are similar to those of Isalo I_{II} (sandstones and claystones). The marine facies is calcareous.

It appears darker grey than I_{II} (and I_I). See on images 1074-06253, 06255, 06262 (bands 5 and 6).

f) Jurassic (J)

Essentially constituted of limestones.

High grade on image 1073-06203, but we saw that the paper-prints were dark.

On image 1074-06262, the grade is probably perturbed by a thin cloudy cover.

g) Cretaceous (c)

Limestones and sandstones.

Pretty high grade on image 1073-06203 (same restrition as above) On image 1074-06253 it appears about with the same grade than J and I_{III}.

. / .

h) Eocène (e)

Essentially calcareous, shows a large development in the Mahafaly district (SW of the island). Grade tone is not evident because of clouds and vegetation covers.

To resume, it is difficult to give definite grade tone for each formation, it is only possible to say :

Sakoa and Sakamena formations appear with higher grade tone than Isalo formations.

From Isalo formations, Isalo II appears the lightest (especially with band 5).

Jurassic, Cretaceous appear with about the same grade tone than Isalo III, that is to say lightly clearer than Isalo I.

The sedimentary formations are rather lighter than Basement. Amongst basement rocks, acid types are lighter than basic types. Quartzitic and granitic rocks appear with the lightest grades tone but vary in detail.

The lithological boundaries are not always very clearly expressed. They depend not only of the colour of rocks, but also of the morphologic aspect, due to the texture and hardness of the rocks, of the covering of vegetation, according to the chemical composition, porosity ... of the rock, of the alteration, and so on. When caracteristics are strongly contrasted between adjoining formations, the boarders appear more accurately.

Some kinds of rocks appear also much more fractured than other ones (migmatits and granits of the Kalambatitra area).

Some bodies appear quite well delineated, such as Bevato gabbro, and Ambohiby granit (image1074-06250).

By the way, it might be possible to distinguish the different kinds of granits, according to their ages ?

Quartzitic beds and stratoïd granits are generally conspicuously pointed out. They form distinctiv units : quartzitic bodies with locally circular structures and regularly delineated strates of granit.

III - SUMMARY AND CONCLUSIONS

The first attempts of evaluation ERTS imagery of South Madagascar confirm in large parts the anticipated value for geoscientific study.

Most of known fractures can be identified, and a number of new observations can be made, in the field of linear features. Some of them extend or relay known fractures, and much others are new ones.

A limiting factor, sometimes tedious for the interpretation, is non-overlapping of images which don't allow the stereoscopic effect. the

Another limiting factor is the non-covering of the eastern coast, where are located the bauxitic outcrops.

Nevertheless, concerning linear structural elements, the study of ERTS imagery allows to help very much the conventionnal methods and gives more complete understanding of major structural elements and tectonical events.

Let us underline another time, the possibility drawn from ERTS imagery, to translate deep structural elements, under rocks cover, on the surface (by till now not clear criteria). Such an idea has previously been mentionned in a former report by Mr SCANVIC and Mr WEECKSTEEN, concerning the Metz and Jurenzé faults and the double fault of the Marne. Another example in France, is the Nîmes fault, in the boarder of the Rhône delta, which is also quite obvious.

./.

The contribution of the scale, linked to the separating power and indirect criteria (geobotanical, retention in water of soils ...) is certainly of major importance.

What already appears from such a study is a convergency with some new general ideas of field geologists, concerning the main structural features of Madagascar. An example of practical interest is for instance the continuity (if proved) of the large band of cipolins running from Betroka to the north of Mangoky river. In the north, this series is known for its Niobium, Tantal, Beryllium bearing pegmatits, whereas in the south the O N U prospection found interesting shows of rare earths. Therefore, a prospecting all along this band, would be of great interest.

On the lithological point of view, different sorts of rocks may be distinguished, as well eruptiv and metamorphic rocks, than sedimentary formations and superficial cover. Nevertheless, it must be pointed out that the accuracy of lithological boundaries is not steady and that a "certain carefulness" is necessary in their drawing.

IV - BIBLIOGRAPHICAL REFERENCES AND MAPS

. Carte géologique à 1'échelle du 1/1 000 000 (1965)

Service géologique de Madagascar (Tananarive).

. Carte géologique à 1'échelle du 1/500 000 (1970)

Service géologique de Madagascar (Tananarive).

. Carte internationale du tapis végétal à 1/1 000 000 (1965)

C.N.R.S. - O.R.S.T.O.M.

. Carte d'aéromagnétométrie à 1/100 000 (1965)

Société S.A.P.A.

. Carte pédologique de Madagascar à 1/1 000 000

O.R.S.T.O.M. (Tananarive).

. Carte géologique à 1/2 000 000 (1973)

G. HOTTIN, B.R.G.M. (not yet printed)

- Volcanisme, tectonique
- Schéma stratigraphique du Précambrien.

. Notice explicative et carte tectonique du socle de Madagascar (1969)

L. RADELLI, P.N.U.D.

o
o o
o

- 1 - *J. BOULADON (1972)*

Réflexions sur 1'accident géologique Ranomena-Ranotsara (Madagascar)

Note B.R.G.M. RME/EX.

- 2 - *J. BOULANGER, G. NOIZET, H. de la ROCHE (1957)*

Géologie de 1'extrême sud de Madagascar - Réunion C.C.T.A.

Tananarive.

. / .

- 3 - *J. CHANTRAINE (1970)*

Géologie de la région Nord d'Ihosy.

Comptes rendus de la semaine géologique de Madagascar p.63-68.

- 4 - *J. CHANTRAINE, L.RADELLI (1970)*

Tectono-minerogenetic units of the Basement of Madagascar.

Economic Geology vol.65 - 1970 -

- 5 - *R. FAUCK (1964)*

Les sols rouges faiblement ferrallitiques d'Afrique occidentale.

C.R. 8e congrès Int.Sci.Sols, Bucarest, V, bibliogr.

- 6 - *G. JOURDE (1971)*

Essai de synthèse structurale et stratigraphique du Précambrien malgache.

Sem. Géol. Mad. 1971.

- 7 - *B. LAMBOLEZ (1973)*

Etude géophysique de l'accident tectonique Ranomena-Ranotsara (Madagascar). Note B.R.G.M.

- 8 - *LEXIQUE STRATIGRAPHIQUE INTERNATIONAL (par H. BESAIRIE, M. COLLIGNON)-(1960)*

Vol. IV Afrique - fasc. II - Madagascar.

Congr. Géol. intern. Copenhagen.

- 9 - *B. MOINE (1971)*

Caractères de sédimentation et de métamorphisme des séries précambriennes épizonales à catazonales du centre de Madagascar.

C.N.R.S. Thèse Nancy 1971.

- 10 - *G. NOIZET (1967)*

Les formations androyennes du sud de Madagascar.

C.R. Sem. Géol. Tananarive.

- 11 - *G. NOIZET (1968)*

Structure du socle malgache au sud de Tananarive.

C.R. Sem. Géol. Tananarive.